

# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors: Michael J. Hammond; Gregory T. Reynolds  
Assignee: Nanometrics Incorporated  
Title: Focusing System and Method  
Serial No.: 10/572,329 Filing Date: December 12, 2006  
Examiner: Thong Q. Nguyen Group Art Unit: 2872  
Docket No.: NAN138 US (8011) Confirmation No.: 1323

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Saratoga, California  
February 24, 2010

Mail Stop Appeal Brief - Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

## **APPEAL BRIEF**

Dear Sir:

This Appeal Brief is filed on behalf of the Appellants in the above-referenced case pursuant to the Notice of Appeal filed on March 3, 2009, and the Notice of Panel Decision and Pre-Appeal Brief Review dated April 30, 2009 and in response to the Notification of Non-Compliant Appeal Brief dated February 23, 2010.

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**(1) Real Party in Interest**

The real party in interest is Nanometrics Incorporated, the assignee of record.

**(2) Related Appeals and Interferences**

There are no appeals or interferences that could directly affect or be directly affected by or have a bearing on the decision by the Board of Patent Appeals in the pending appeal.

**(3) Status of Claims**

Claims 1-10, 12-14, and 16-17 are pending. Claims 1-8, 10, 12-14, and 16-17 stand rejected. Claim 9 has been allowed. The rejection of Claims 1-8, 10, 12-14, and 16-17 is appealed.

**(4) Status of Amendments**

An amendment to claim 9 filed on January 28, 2009, subsequent to the final rejection of December 4, 2008, was entered for purposes of appeal.

An amendment to the specification, including a substitute specification, filed on January 28, 2009, subsequent to the final rejection of December 4, 2008, was entered.

## **(5) Summary of Claimed Subject Matter**

Page and line numbers referred to herein are based on the substitute specification submitted on January 28, 2009, which has been entered. A replacement page for the only figure (Fig. 1) was entered on August 29, 2008. All references to the drawings are to Fig. 1 in the replacement page.

The independent claims are 1 and 12. The claimed subject matter is related to a method and an apparatus for automatically focusing on a generally planar object in bright field microscopy. Page 1, lines 10-12. The automatic focusing is achieved by splitting light reflected from an object into two images {31, 32} from eccentric sections of an imaging pupil differentially displaced from the optical axis, which can be used to determine the focus conditions, as described at page 8, lines 1-7 and page 11, lines 10-15, the separation of the images is used to determine the focus conditions.

The subject matter recited in independent claim 1 is directed to a method of automatically focusing a microscope. As shown in Fig. 1 and described generally at page 11, lines 7-18, the microscope includes a light source {21}, an objective lens {25}, a light path to direct incident light through the objective lens to be reflected by an object {26a}, an aperture {33} to limit the spatial extent of the incident light and serve as an illumination pupil, a light path to direct at least some of the reflected light to an imaging system {27, 28, 29 and 11, collectively}, and an imaging system to image the reflected light. The method includes directing a beam of light from a light source {21} through an objective {25} of a microscope system to an object {26a}, as described at page 11, lines 7-9. Light is reflected from the surface of the object and at least some of the reflected light is collected and directed to the imaging system as described at page 8, lines 1-7 and page 11, lines 9-15. The beam of light is limited in spatial extent by imaging an aperture {33} to form an illumination pupil as described at page 8, lines 1-7 and page 11, lines 17-15. A centroid of illumination of the illumination pupil is aligned with an incident optical axis, which is described at page 6, lines 25-28. The method includes splitting the reflected light that is projected to the imaging system into at least two images {31, 32} from eccentric sections of an imaging pupil differentially displaced from the optical axis as described at page 8, lines 1-7 and page 11, lines 10-15. The separation of the images

thereby produced is determined to provide an indication of a focus condition as discussed at page 5, lines 25-28 and page 11, line 28 to page 12, line 1.

The subject matter of independent claim 12 is related to a microscope 12. As illustrated in Fig. 1 and described at page 11, lines 7-18, the microscope includes a light source {21}, an objective lens {25} and a first light path to direct incident light from the light source {21} through the objective lens {25} to be reflected by an object {26a} as discussed at page 11, lines 7-10. The microscope also includes an aperture {33} that limits the spatial extent of the incident light and serves as an illumination pupil with the centroid of illumination from the illumination pupil on an optical axis, which is described at page 6, lines 14-28 and page 11, lines 17-18. Additionally, the microscope includes an imaging system {27, 28, 29 and 11, collectively} and a second light path to direct reflected light from the object {26a} to the imaging system as discussed at page 11, lines 9-15. The imaging system includes optics {28} to split the reflected light into at least two images {31, 32} from eccentric sections of an imaging pupil differentially displaced from the optical axis as discussed at page 8, lines 1-7 and page 11, lines 10-15, along with a camera {11} to measure the separation of the images thereby produced to provide an indication of a focus condition as discussed at page 5, lines 25-28 and page 11, line 28 to page 12, line 1. Additionally, the microscope includes a control system {CS} to adjust mechanically the separation of the object from the objective lens as discussed at page 6, lines 7-9.



**(6) Grounds of Rejection to be Reviewed on Appeal**

Whether claims 1-8, 10, 12-14 and 16 are unpatentable under 35 U.S.C. §102(b) as being anticipated by Mueller (U.S. Patent No. 4,025,785).

Whether claim 17 is unpatentable under 35 U.S.C. §103(a) over Mueller (U.S. Patent No. 4,025,785) in view of Goto (U.S. Patent No. 5,477,303).

(7) Argument

**Rejection of 35 U.S.C. §102(b) over Mueller**

**Claims 1, 2, 5-8, 10, 12, 13, 16**

Independent claim 1 addresses a method in which the “reflected light is projected to the imaging system in which the reflected light is split into at least two images from eccentric sections of an imaging pupil differentially displaced from the optical axis”.

Independent claim 12 addresses a microscope with “the imaging system comprising optics to split the reflected light into at least two images from eccentric sections of an imaging pupil differentially displaced from the optical axis”.

With respect to the rejection under §102, claims 1, 2, 5-8, 10, 12, 13 and 16 stand or fall together.

The Examiner states that Mueller discloses claims 1 and 12 and specifically Muller discloses “a common objective lens (1) for focusing illuminating light onto an object (4); c) a focus and imaging system comprises a set of objective lenses (2, 3); dihedral mirrors or beamsplitters (20, 21)...” (Office Action dated May 1, 2008, page 11, lines 20-23; and Office Action dated December 4, 2008, page 4, lines 8-11). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action dated August 29, 2008, page 10, line 26 to page 11, line 3.) The response is that claims 1 and 12 require that “the reflected light is split into at least two images from eccentric sections of an imaging pupil differentially displaced from the optical axis”. Mueller, on the other hand, does not split the reflected light, as recited in claims 1 and 12. Mueller instead uses objectives 2 and 3 to “image the object 4 at the intermediate image planes 5 and 6” which correspond to “intermediate image planes 28 and 29”. Col. 2, lines 62-63 and col. 3, lines 31-33. Mueller discloses that blades 26 and 27 are used to “partially block the respective fields of view in the vicinity of the intermediate image planes 28 and 29” and relies on the shifting of the paths of the rays in front of the objective lens 1 when the object 4 is moved out of the focal plane. Col. 3, lines 27-32 and see col. 3, line 58 to col. 4, lines 4. Thus, Mueller does not split the reflected beam “into at least two images from eccentric sections of an imaging pupil” as recited in claims 1 and 12.

In the Response to Argument section of the Office Action dated December 4, 2008, the Examiner stated “applicant’s arguments do not comply with 37 CFR 1.111(c) because they do not clearly point out the patentable novelty which he or she thinks the claims present in view of the state of the art disclosed by the references cited or the objections made. Further they do not show how the amendments avoid such references or objections.” (Office Action dated December 4, 2008, page 7, 2nd paragraph). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action dated January 28, 2009, page 7, lines 21-30) The response is that Appellant’s Office Action dated August 29, 2008, identified a feature that is recited in the independent claims, e.g., the “the reflected light is split into at least two images from eccentric sections of an imaging pupil differentially displaced from the optical axis”, and explained why Mueller does not disclose at least this feature.

In the Response to Argument section of the Office Action dated December 4, 2008, the Examiner stated Mueller discloses splitting the reflected light as “the objective lens (1) acts as an optics for splitting light reflected from a spot (17a) of an object (4) to an imaging system having a first imaging system 32, 33)...” (Office Action dated December 4, 2008, page 7, lines 12-17). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action dated January 28, 2009, page 8, line 4 to page 9, line 4). The response is that the Examiner’s position 1) either lacks a factual basis or is based on improper claim interpretation; and 2) fails to make a prima facie case.

#### Lack of Factual Basis

The objective lens 1 of Mueller, in fact, does not “split” the light reflected from the spot 17a of an object 4. An objective lens focuses light and produces a real image of the object being observed. In fact, it is not the objective lens 1 by itself that presents images of the object 4 at the intermediate image planes 5 and 6, but is the combination of objective lens 1 with additional objective lenses 2 and 3. Col. 2, lines 58-68 and Fig. 1. The objective lenses 2 and 3 are offset from the center of the objective lens 1 and thus, produce images of the object 4 at slightly different perspectives, which explains why

Mueller refers to his system as a “stereoscopic microscope”. See, Title, and col. 2, lines 58-68. The objective lens 1 and objective lenses 2 and 3, however, do not “split” the reflected light ... into at least two images” as recited in claims 1 and 12. Instead, Mueller discloses the use of objective lenses 2 and 3, with objective lens 1, to image the object 4 from two different perspectives. Thus, contrary to the Examiner’s statement, Mueller does not disclose “the reflected light is split into at least two images from eccentric sections of an imaging pupil” as recited in claim 1 or “optics to split the reflected light into at least two images from eccentric sections of an imaging pupil” as recited in claim 12. There is no factual basis for the Examiner’s position that the objective lens (1) acts as an optic for splitting light.

#### Improper Claim Interpretation

Appellants submit that to maintain the Examiner’s position requires ignoring the explicitly recited term “split”. Mueller uses objective lens 1 (and objective lenses 2 and 3) to image the object from different perspectives. An object lens does not “split” light. Thus, to maintain the Examiner’s position requires that the term “split” be ignored, which is improper.

#### No Prima Facie Case

Additionally, Appellant’s independent claims 1 and 12 both require that the reflected light is split into the two images within the imaging system. For example, independent claim 1 recites the “reflected light is projected to the imaging system in which the reflected light is split into at least two images ...” and independent claim 12 recites “the imaging system comprising optics to split the reflected light into at least two images....”

As discussed above, the Examiner’s rejection is based on “the objective lens (1) acts as an optics for splitting light reflected from a spot (17a) of an object (4) to an imaging system ....” Even if one were to accept the Examiner’s position that the objective lens 1 splits the reflected light and provides that light an imaging system, which Appellants do not, Mueller still does not anticipate independent claims 1 and 12 as Mueller does not disclose splitting the reflected light within the imaging system.

Appellants point out that the Examiner does not interpret Mueller as disclosing that the object lens 1 is part of the imaging system. The Examiner states “the objective lens (1) acts as an optics for splitting light reflected from a spot (17a) of an object (4) to an imaging system”, clearly indicating that the objective lens 1 and the imaging system are separate elements. Moreover, an interpretation that the “objective lens” is part of the “imaging system” would be improper because both claims 1 and 12 recite an “objective lens” and “an imaging system” separately, thereby indicating that these elements are distinct. If the “objective lens (1)” of Mueller is considered part of the “imaging system,” then Mueller fails to disclose an objective lens that is separate from the imaging system as required by claims 1 and 12.

In the Response to Argument section of the Office Action dated December 4, 2008, the Examiner also stated that “Applicant should note that the claims 1-8, 10, 12-14 and 16 have not recited any specific limitation(s) related to the component(s) used to split the reflected light”. (Office Action dated December 4, 2008, page 7, lines 17-19). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action dated January 28, 2009, page 9, lines 5-13). The response is that claims 1-8, and 10 are directed to a method, not an apparatus, and thus, the physical component that performs the act need not be recited. Further, claim 12 recites “the imaging system comprising optics to split the reflected light into at least two images”, which includes the component used to split the reflected light. Moreover, dependent claim 14 further recites that “wherein the optics ... comprises a dihedral mirror”, which again is a specific limitation related to the component used to split the reflected light. Accordingly, Appellants submit that specific limitations related to the components used to split the reflected light are recited.

Thus, Appellants respectfully submit that independent claims 1 and 12 are patentable over Mueller. Reconsideration and reversal of this rejection is respectfully requested.

Claims 2, 5-10 and 16 depend from claim 1 and claims 13 and 17 depend from claim 12 and therefore claims 2, 5-10, and 13 are likewise patentable for at least the same reasons.

### **Claims 3-4**

The Examiner states that Mueller discloses claims 3 and 4 and specifically Muller discloses “a detecting system comprises detectors (32,33)...” (Office Action dated May 1, 2008, page 11, line 25; and Office Action dated December 4, 2008, page 4, line 12). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action dated August 29, 2008, page 11, 8-10 and Amendment and Response to Office Action dated January 28, 2009, page 9, lines 19-21). The response is that claim 3 recites “projecting the images onto a single imaging means within the imaging system”. Mueller, on the other hand, discloses the use of two separate photoelectric detectors 32 and 33. Col. 3, lines 32-40. Thus, a *prima facie* case has not been made with respect to claim 3. Claim 4 depends from claim 3 and is patentable for at least the same reason.

### **Claim 14**

The Examiner states that Mueller discloses claim 14 and specifically Muller discloses “dihedral mirrors or beamsplitters (20, 21)...” (Office Action dated May 1, 2008, page 11, line 23; and Office Action dated December 4, 2008, page 4, line 11). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action dated August 29, 2008, page 11, lines 11-14 and Amendment and Response to Office Action dated January 28, 2009, page 9, lines 22-31.) The response is that claim 14 recites that “the optics to split the reflected light into at least two images from eccentric sections of the imaging pupil comprises a dihedral mirror.” Mueller, on the other hand, does not disclose splitting the reflected beam into the two images from eccentric sections of the imaging pupil, much less, using a dihedral mirror to do so.

In the Response to Argument section of the Office Action dated December 4, 2008, the Examiner stated Mueller includes a “first imaging system which is [sic] clearly includes a pair of the beamsplitter or dihedral mirror”. (Office Action dated December 4, 2008, page 8, lines 1-2). In response, Appellants previously pointed out to the Examiner why the Examiner is believed to have erred. (Amendment and Response to Office Action

dated January 28, 2009, page 9, lines 22-31.) The response is that Mueller does not disclose a dihedral mirror. In fact, the Examiner recognizes that Mueller fails to disclose a dihedral mirror in the allowance of claim 9. In the section titled “Allowable Subject Matter” in the Office Action dated December 4, 2008, the Examiner stated “Such use of a dihedral mirror is not disclosed in the microscope provided by the mentioned Patents.” Thus, Appellants submit that a *prima facie* case has not been made with respect to claim 14 and claim 14 should be allowable for at least the same reasons that claim 9 has been indicated as being allowable.

### **Rejection of 35 U.S.C. §103(a) over Mueller in view of Goto**

#### **Claim 17**

The Examiner states that Mueller in view of Goto discloses claim 17 and specifically that Mueller does not disclose the use of “selective optics to divert reflected light” but that Goto discloses “the use of a beam splitter or a retractable mirror for diverting light from an object to either a first imaging system or a second imaging system”. (Office Action dated December 4, 2008, page 5, line 19 to page 6, line 4). Appellant’s response includes a new argument that has not been previously presented to the Examiner. The response is that Goto does not make up for the deficiencies of Mueller described above. Accordingly, Claim 17 is patentable over the combination of Mueller in view of Goto for at least the same a reasons that claim 12 is patentable over Mueller.

For the above reasons, Appellants respectfully request reversal of the rejection of claims 1-8, 10, 12-14, and 16-17. The Commissioner is hereby authorized by the undersigned to debit Deposit Account 50-2263 for any underpayment or any additional

fees deemed necessary including extension fees. Should there be any questions concerning this Appeal Brief, please contact the undersigned.

Respectfully submitted,

Dated: February 24, 2010

By: 

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## **Claims Appendix**

The following claims are involved in this appeal:

1. (Rejected) A method of automatically focusing a microscope having a light source, an objective lens, a light path to direct incident light through the objective lens to be reflected by an object, an aperture to limit the spatial extent of the incident light and serve as an illumination pupil, a light path to direct at least some of the reflected light to an imaging system, and an imaging system to image the reflected light so directed, the method comprising: directing a beam of light from a light source through an objective of a microscope system to an object whereby light is reflected from the surface thereof; collecting at least some of the light reflected thereby and directing the same to an imaging system, wherein the incident beam of light is limited in spatial extent by imaging an aperture to form an illumination pupil, a centroid of illumination of the illumination pupil is aligned with an incident optical axis, and reflected light is projected to the imaging system in which the reflected light is split into at least two images from eccentric sections of an imaging pupil differentially displaced from the optical axis, and wherein the separation of the images thereby produced is determined to provide an indication of a focus condition.
  
2. (Rejected) The method of claim 1 wherein an illumination beam is injected into the top focal plane of the objective limited in its spatial extent and bounded by imaging an aperture so as to form an illumination in the top focal plane of the objective.

3. (Rejected) The method of claim 2 comprising the formation of a plurality of images of the object using sections of the imaging pupil with differing eccentricities and projecting the images onto a single imaging means within the imaging system.
4. (Rejected) The method of claim 3 wherein the imaging means comprises a single detector array.
5. (Rejected) The method of claim 1, further comprising successively repeating actions to obtain separate pairs of images from eccentric sections of the imaging pupil, measurements of the separation of the successive pairs of images being used as part of iterative process to improve the accuracy of the focus condition.
6. (Rejected) The method of claim 1 wherein the light source that is used to produce the light beam that is reflected and directed to the imaging system the same light source as used for metrology.
7. (Rejected) The method of claim 1 wherein a beam splitter is used to extract light reflected from the object and direct the same towards the imaging system and a primary observational optical system, the imaging system being separate from the primary observational optical system which is used to image the object, obtain metrology data or other measured data therefrom.

8. (Rejected) The method of claim 1 comprising investigating the focus condition and subsequently conducting observation and/or measurement of the object.

10. (Rejected) The method of claim 1 wherein a field stop is provided as the aperture to limit the spatial extent of the incident light in the beam of light from the light source.

11. (Canceled)

12. (Rejected) A microscope comprising:

a light source;

an objective lens and a first light path to direct incident light from the light source through the objective lens to be reflected by an object;

an aperture that limits the spatial extent of the incident light and serves as an illumination pupil with the centroid of illumination from the illumination pupil on an optical axis;

an imaging system and a second light path to direct reflected light from the object to the imaging system the imaging system comprising optics to split the reflected light into at least two images from eccentric sections of an imaging pupil differentially displaced from the optical axis, and a camera to measure the separation of the images thereby produced to provide an indication of a focus condition; and

a control system to adjust mechanically the separation of the object from the objective lens.

13. (Rejected) A microscope in accordance with claim 12 wherein the imaging system is provided to determine optimal focus position in a first focusing step, the microscope comprising a second imaging system for subsequent observational step, and a beam splitter disposed between the imaging system and the second imaging system to divert reflected light from the object partially to both the imaging system and the second imaging system.

14. (Rejected) A microscope in accordance with claim 12 wherein the optics to split the reflected light into at least two images from eccentric sections of the imaging pupil comprises a dihedral mirror.

15. (Canceled)

16. (Rejected) The method of claim 5, further comprising obtaining the focus condition varying spatially across an object to determine a degree of deviation from planarity.

17. (Rejected) A microscope in accordance with claim 12 wherein the imaging system is provided to determine optimal focus position in a first focusing step, the microscope comprising a second imaging system for subsequent observational step, and selective optics disposed between the imaging system and the second imaging system to divert reflected light from the object selectively to either the imaging system or the second imaging system.

**Evidence Appendix**

NONE

**Related Proceedings Appendix**

NONE